

PROCEEDINGS

OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.



PAPERS.

1. The Comparative Anatomy of the Tongues of the Mammalia. II. Family 1. Simiidae. By CHARLES F. SONNTAG, M.D., Ch.B., F.Z.S., Anatomist to the Society.

[Received October 14, 1920: Read February 8, 1921.]

(Text-figures 1-9.)

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Introduction.

Many papers dealing with the anatomy of the Anthropoid Apes contain details of the macroscopic appearances of the tongues. Most of the authors, however, have limited their accounts to the description of one or more salient features, such as the number and arrangement of the vallate papillæ. More attention, too, has been paid to the large Anthropoids than to

the Gibbons. I have referred to nearly thirty papers, and in no case did I find a complete account of any of the Simian tongues. Even Deniker's paper on the tongue of the Gorilla, which is the best, is incomplete, for it deals mainly with the tongue in the fœtus and says little about its condition in the adult.

For the purpose of the present communication I have examined both fresh and preserved specimens in the Society's Prosectorium and in the Museum of the Royal College of Surgeons, the specimens from the latter being indicated by the words Mus. R.C.S. Of all the tongues examined only the measurements of fresh specimens are given, for the dimensions of preserved ones are worthless. I am indebted to Professor Arthur Keith for permission to examine some of the tongues described in this and future papers.

Genus ANTHROPOPITHECUS.

THE CHIMPANZEE (*A. troglodytes*).

Of the three tongues examined one was fresh, one had been preserved in the Society's Prosectorium, and one (No. J. 359.1) was preserved in the Museum of the Royal College of Surgeons. These are described respectively as specimens one, two, and three. The fresh specimen was a male from Landana, S.W. Africa.

Several writers have stated that Traill first described the tongue of the Chimpanzee in 1821, but Traill's paper is entitled "The Description of an Orang-Outan" (206). He certainly described an arrangement of the vallate papillæ which closely resembles that of the Chimpanzee, but he expressly mentions the tongue as being that of an Orang*.

My fresh specimen has the following measurements:—Total length 9.1 cm.; length from the apex to the antero-median vallate papilla 6.1 cm.; length from that papilla to the epiglottis 3 cm.; width between the lingual attachments of the anterior faucial pillars 4.5 cm.; width of the apex 3 cm.; thickness in the region of the antero-median vallate papilla 3.5 cm.; thickness of the apex .3 cm.

The tongue is long and comparatively narrow, and its width does not decrease greatly from base to apex. Cunningham (118) is the only author who points out that its elongated form is due to the shape of the mouth. He also shows how the tongues of the Chimpanzee and Gibbons differ more from that of Man in the disproportion between length and breadth than does the tongue of the Orang-Outan.

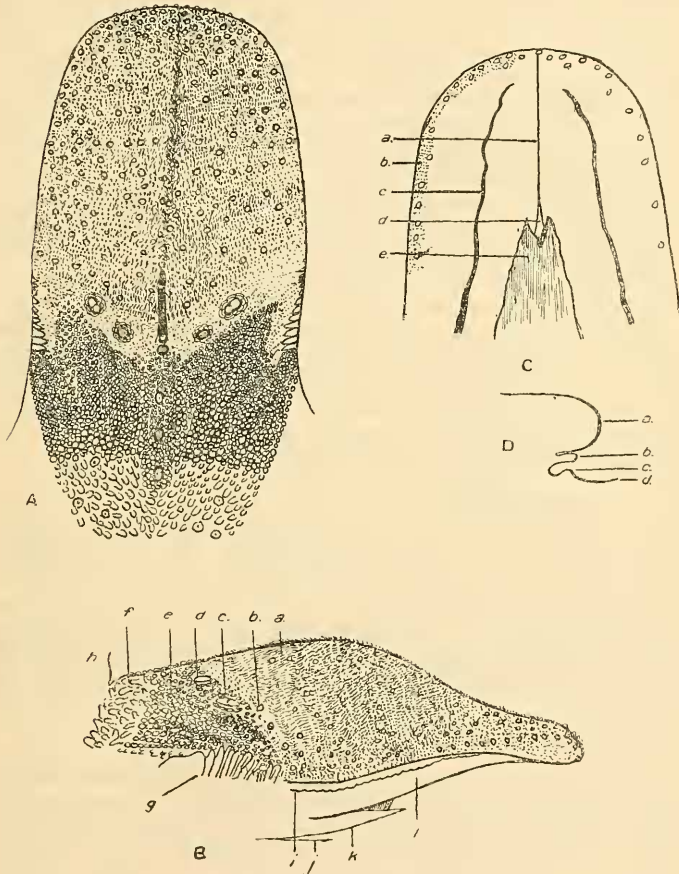
The antero-median vallate papilla stands a short distance behind the summit of an elevation whence the dorsum slopes towards base and apex, but the declivity is greater in the latter direction (text-fig. I B, *d*). In this connection the Chimpanzee

* Flower states that Traill really described a Chimpanzee from the Gaboon.

is pre-eminent among the Anthropoids, but the degree of slope varies in different individuals.

The *Apex and Lateral Borders* exhibit characters which are common to many of the Anthropoids. The *apex* is blunt and may or may not possess a median notch; the notch only occurred

Text-figure 1.



The tongue of *Anthropopithecus troglodytes*.

A. dorsum; B. lateral view; C. inferior surface; D. vertical section of the side of the tongue. Descriptions in text.

in my fresh specimen. It is roughened by conical papillæ and tuberculated by large prominent fungiform papillæ. Their size varies in different tongues, but they are always numerous; some are smooth, glistening, and hemispherical, others are granular

and hemispherical, and others may possess a central boss (text-fig. 2 A, *l, m, n*). All the conical papillæ have their points directed backwards. The *lateral borders* are full and rounded (text-fig. 1 D, *a*); they are beset with both conical and fungiform papillæ, and the lateral organs are situated at their posterior extremities (text-fig. 1 B, *g*).

Mesial Sulci.—Mesial sulci may be present on the dorsal and inferior surfaces. In my fresh specimen (text-fig. 1 A) the *median dorsal sulcus* extends from the apical notch to a point 4 mm. in front of the antero-median vallate papilla. It is irregular and invaded by both conical and fungiform papillæ: posteriorly it is deep and lodges fungiform papillæ alone. On the base of the tongue the median row of vallate papillæ is situated on a depressed band of mucosa which is bounded by large papillæ and lymphoid nodules.

In my second specimen there is, instead of a median sulcus, a row of prominent fungiform papillæ, and the only representative of the fissure is a small pit, lodging a fungiform papilla, lying immediately in front of the antero-median vallate papilla.

In my third specimen (No. J. 359.1, Mus. R.C.S.) there is neither a median sulcus nor a median row of fungiform papillæ, but there is a pit in front of the antero-median vallate papilla.

The small pit described above must not be mistaken for the *foramen cæcum of Morgagni* which is absent in the Chimpanzee.

The *median ventral sulcus* will be described later.

Transverse ridges and sulci are absent.

The Papillæ.

Papillæ are present on the entire dorsum, apex, lateral borders, and a bounding zone on the inferior surface. This *general distribution* is so common among the Anthropoids that it can be regarded as the rule. The only exceptions are the Orang-Outan and the Siamang Gibbon, which have areas on the base which are devoid of papillæ. I am unable to say whether these smooth areas exist in all Siamangs, but they are not present in all Orangs.

The Circumvallate Papillæ (text-fig. 1 B, *c & d*).

The vallate papillæ vary in number and arrangement in different individuals, but the relation between the species of Chimpanzee and the papillary pattern has not been stated by authors. The following types have been described:—

T-form: Flower (28); Dwight (123); Symington (202); Huxley and Hunter.

Y-form: Gratiolet and Alix (131); Bischoff (7); Münch [1].

V-form: Cavanna (109); Ehlers (23).

Cruciate form: Mayer (162).

Linear type: Humphry (142).

The numbers of vallate papillæ vary from three, as recorded by Wyman (215), to fifteen mentioned by Humphry (142).

In my three specimens the arrangements are as follows:—

Specimen No. 1.—There are eight papillæ arranged in the Y-form (text-figs. 1 A & 2 B). Each lateral limb has an outer compound and an inner simple papilla, and the mesial antero-posterior row consists of four simple elements.

The papillary bodies of the compound papillæ are oval on plan; the inner papillæ of the lateral rows are circular; the antero-median papilla is circular, and the other three papillæ are oval on plan. All the papillæ are conical on elevation (text-figs. 2 A, *r*, & 1 B, *c*), the narrow ends of the cones being attached to the bottom of the fossæ. The surfaces are all granulated, possibly by secondary papillæ. The vallums are lobulated, and the fossæ are more or less patulous (text-fig. 2, *p*, *q*, *t*).

Specimen No. 2.—There are eight papillæ arranged in the Y-form, and all of them are simple (text-fig. 2 B). The left lateral row has three papillæ, the right lateral limb has two, and the mesial antero-posterior limb has three. All the papillæ of the lateral limbs are circular and prominent, and the vallums and fossæ are well marked. They are surrounded by papillose ridges passing inwards from the corresponding lateral organs. The median row of papillæ consists of oval elements well recessed beneath their vallums. The most posterior papilla is difficult to see unless the pedunculated papillæ of the base of the tongue are withdrawn from over it.

In *Specimen No. 3* the arrangement of the vallate papillæ is uncommon. There are eight papillæ in the Y-form (text-fig. 2 B), but the two lateral limbs lie closely side by side, and the vertical limb has one papilla. The left lateral limb has four papillæ and the right one has three.

The Fungiform Papillæ (text-figs. 1 B, *b*, & 2 A, *m*, *n*, *o*).

Fungiform papillæ are numerous and cover the dorsum, apex, lateral borders, and a bounding zone on the inferior surface. They have the usual arrangement in clusters behind the apex, transverse rows farther back, and oblique chains in front of the vallate papillæ. On the lateral borders they are arranged vertically, and on the inferior surface they are in straight lines passing from without inwards.

They invade the median dorsal sulcus, and may replace it altogether. In one of my specimens there is a well-marked median row of prominent fungiform papillæ in place of the median sulcus.

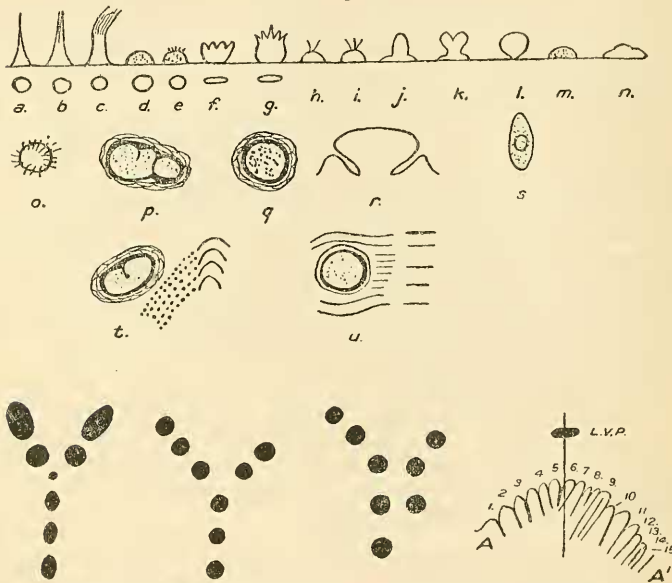
In one of my specimens there are more fungiform papillæ than those presented to the naked eye, for the lens shows how filiform papillæ entirely conceal many fungiforms.

At the base of the tongue (text-fig. 1 A) there are many long *pedunculated papillæ* which belong to both fungiform and conical groups. It is only possible, however, to settle by microscopic examination to which of them any particular papilla can be referred. They vary in degree of development in different

tongues, and I agree with Humphry (142) that some of them may be a quarter of an inch long.

These pedunculated papillæ are smaller and fewer than in the Gorilla, and larger and more numerous than in the Gibbons. They are absent altogether in the Orang-Outan. Their surfaces are smooth or granular. The different forms of papillæ are shown in text-fig. 2 A, *m-o*.

Text-figure 2.



The papillæ and lateral organs of *Anthropopithecus troglodytes*.

a-l, conical papillæ; *m-o*, fungiform papillæ; *p-u*, circunvallate papillæ; AA', lateral organ; the three figures on the left side of the bottom row are vallate patterns, described in the text as 2 B.

The Conical Papillæ (text-fig. 1 B, *a, e, & f*).

The conical papillæ have the same form of arrangement as the fungiforms, and they are seen to the best advantage when the tongue is allowed to dry, for they then stand up on the surface. All their points are directed backwards.

They increase in *size* from before backwards, and from without inwards, the largest ones on the anterior part of the dorsum being in and around the median sulcus. They overlap the fungiform papillæ and conceal some of them entirely. In one of my specimens they stand on ridges like those on the finger-tips.

They belong to both cylindrical and filiform groups. The *filiform varieties* have one or more points. When there is only one the papilla is tapering, and circular on section. When

there are more than one point the body may be cylindrical, or flat and thin (text-fig. 2 A, *a-g*). The *cylindrical types* are interspersed among the others. They have a granular surface, and some of them are very rough. In the latter case, however, it is difficult to be precise as to their character; they may have lost long points as the result of handling (text-fig. 2 A, *h, i*).

The relative proportions of the filiform and cylindrical types differ in different tongues. Either type may be in excess, and they may in some cases be evenly distributed, but it is usual to find one form predominating.

The different forms are shown highly magnified in text-fig. 2 A, nos. *a-l*.

Lymphoid Tissue.

The base of the tongue contains much lymphoid tissue which gives the surface a lobulated appearance, and there is a great contrast between it and the rough anterior surface when the tongue is viewed from the side (text-fig. 1 B). The degree of contrast depends greatly on the number of filiform papillæ on the anterior two-thirds of the dorsum; when these are very numerous the roughness is greater and the contrast more marked.

The lymphoid nodules vary in size, and the large ones have small central pits, but it is only possible to tell by microscopic examination whether any one orifice has ducts of glands connected to it or not. Few of the pitted follicles lie anterior to the most posterior vallate papilla.

The Lateral Organs (text-figs. 1 B, *g*, & 2, AA').

Boulart and Pilliet [2] have stated that the lateral organs of the Anthropoid Apes are well developed, and mention that the Chimpanzee has twelve ridges in its organs, but they do not say whether both organs have the same number of fissures and ridges. Dwight (123) showed that each organ is convex internally. I agree with Dwight, but not with Boulart and Pilliet. All my specimens have organs convex inwardly, but there is great variability in the number of fissures and ridges as the following figures show:—

Specimen 1 (text-fig. 2, AA').

Right organ :	<i>Length</i> 1.55 cm.	<i>Ridges</i> 15.	<i>Sulci</i> 16.
Left organ :	<i>Length</i> 1.6 cm.	<i>Ridges</i> 14.	<i>Sulci</i> 15.

Specimen 2.

Right organ :	<i>Length</i> 1.4 cm.	<i>Ridges</i> 7.	<i>Sulci</i> 8.
Left organ :	<i>Length</i> 1.7 cm.	<i>Ridges</i> 9.	<i>Sulci</i> 10.

Specimen 3.

Right organ :	—	<i>Ridges</i> 10.	<i>Sulci</i> 11.
Left organ :	—	<i>Ridges</i> 9.	<i>Sulci</i> 10.

Each organ begins anteriorly as a number of sulci on the infero-lateral aspect of the tongue, but the pieces of the tongue

between them are not raised above the general surface. Behind these the ridges appear and increase both in length and prominence till a point is reached almost level with the outermost vallate papilla of the corresponding lateral row. After that they diminish in size, but increase in prominence till the posterior limit of the organ is reached. Many ridges are simple, but a few are divided by small secondary sulci.

Ridges pass across the dorsum from the upper ends of the ridges of the lateral organs. These either encircle the vallate papillæ or pass backwards on their outer side.

The Inferior Surface (text-fig. 1 C & 1 B, l).

The inferior surface presents for examination a mesial sulcus, two plicæ fimbriatæ, the papillary border, frenum and sublingual fold, or frenal lamella, so called by Pocock (text-fig. 1 B, k, & 1 C, e).

The *mesial sulcus* (text-fig. 1 C, a) extends backwards from the posterior border of the papillary zone to the attachment of the frenum. It is not occupied by any crest as in the Gorilla.

The *plicæ fimbriatæ* (text-fig. 1 C, c) are, it is acknowledged, remnants of the sublingua of the Prosimiæ, and in one of my specimens the two plicæ and intervening piece of mucous membrane have the appearance of an under tongue.

The plicæ are two longitudinal folds, almost touching in front, running backwards and outwards from near the apex to a point well behind the middle of the tongue, but in one of my specimens they are nearly parallel to one another. They lie on the lateral aspects of the inferior surface between the mesial sulcus and the edges of the tongue. Each one has undulating and crenated edges, and increases in width from before backwards.

When a vertical section of the tongue is made about its centre (text-fig. 1 D) one sees the mucosa of the floor of the mouth (d) reflected to form the frenal lamella (c). From the upper surface of the latter it is reflected on to the plicæ (b), and thence to the under surface of the tongue (a). The mucosa between the plicæ fimbriatæ and the sublingual fold is thrown into many small folds.

The Sublingual Fold (text-fig. 1 C, e).

The sublingual fold, or frenal lamella (Pocock), lodges Wharton's Ducts. It is triangular in shape with the base behind. The apex is bifid and the two ducts open on the points which are very sharp; the edges are undulating and crenated. Its mucosa is continuous with that of the floor of the mouth below and the frenum linguæ above.

Some have said that the sublingual fold corresponds to the sublingua of the Prosimiæ, but most anatomists are agreed that the plicæ fimbriatæ represent it, so the tongue of the Chimpanzee, which possesses both, is sufficient to disprove the statements of the former group of observers.

The Papillary Border (text-fig. 1 C, b).

The narrow papillary border has fungiform and conical papillæ, the latter belonging to the filiform and cylindrical groups. They are arranged in lines passing from without inwards. The fungiform papillæ are small and most numerous beneath the apex of the tongue.

The Frenum Linguae (text-fig. 1 C, d).

The frenum is short and thick. It runs from the upper surface of the sublingual fold to the under surface of the tongue from the posterior end of the median ventral sulcus backwards.

No *lytta* is present in the interior of the tongue.

When the apex is examined histologically, no *Apical Gland of Nuhn* is seen. In this connection it agrees with the Gorilla and Gibbons, and differs from Man and the Orang-Outan.

There is only a narrow groove between the base of the tongue and the epiglottis (text-fig. 1 B, h).

Genus GORILLA.

THE GORILLA (*G. gorilla*).

The literature containing details of the structure of the tongue of the Gorilla is not so large as that dealing with the tongue of the Chimpanzee, but the papers are more complete. Ehlers (23), Bischoff (7), and Duvernoy (22) have written accounts of the adult tongue, and Deniker (17) has described the fœtal tongue very fully, but he has said little about the adult form. Boulard and Pilliet [2] have not mentioned the Gorilla in their study of the lateral organs of the Mammalia. The specimen which I examined (No. J. 358.1, Mus. R.C.S.) exhibits features which have not been mentioned by these authors, or are different from the conditions described by them.

The tongue has not such a great disproportion between its length and width as that of the Chimpanzee. It is comparatively broad, and in this connection I agree with Bischoff (7), and differ from Duvernoy (22) who said it is narrow. The whole organ appears rectangular. It slopes gently from the vallate papillary region to the apex, and more steeply from the vallate region to the epiglottis; it differs, therefore, from the tongue of the Chimpanzee.

The *apex* is square-cut, has no mesial notch, and bears conical and fungiform papillæ which are thickly clustered; the latter are not so prominent as in the Chimpanzee, but are more marked than in the Orang-Outan.

The *lateral borders* have large and medium-sized fungiform and conical papillæ arranged in vertical lines, and they are fissured by numerous sulci prolonged on to them from the dorsum. At their posterior extremities one sees the outer ends of the fissures and laminae of the lateral organs. In this respect the tongue agrees with that of the Orang-Outan, and differs from those of

the Chimpanzee and Gibbons, in which most of the lateral organs lie on the lateral borders of the tongue.

Mesial Sulci.—Mesial sulci are present on the dorsal and inferior surfaces. The *dorsal sulcus* lies in the centre of the anterior two-thirds; it is wide and shallow, and contains many conical and few fungiform papillæ. Just in front of the antero-median vallate papilla there is a small pit containing both conical and fungiform papillæ, but this must be regarded as a part of the mesial sulcus. It must not be mistaken for a *foramen cecum*, which does not exist in the Gorilla. There is no median sulcus on the base of the tongue.

The *median ventral sulcus* (text-fig. 3 B, c) begins in front at the posterior edge of the papillary zone and runs back, widening as it goes, till it terminates in a triangular pit into which the frenum passes. It lodges a median fold of mucous membrane termed the *plica mediana* or *mesial crest* (text-fig. 3 B, d).

Transverse Ridges and Sulci.—Several transverse ridges and sulci are present on the anterior two-thirds of the dorsum. They are undulating and irregular in direction, and some of them cut the lateral borders of the tongue and run inwards on the bounding papillary zone of the inferior surface. The sulci are narrow and the ridges are covered with papillæ.

In the interior of the tongue there are neither *lytta* nor *Apical Gland of Nuhn*.

The Papillæ.

Papillæ are present on the entire dorsum, apex, lateral borders, and a bounding zone on the inferior surface. The last is better developed than in the Chimpanzee and Orang-Outan.

The Circumvallate Papillæ (text-figs. 3 A & 3 D, a, b).

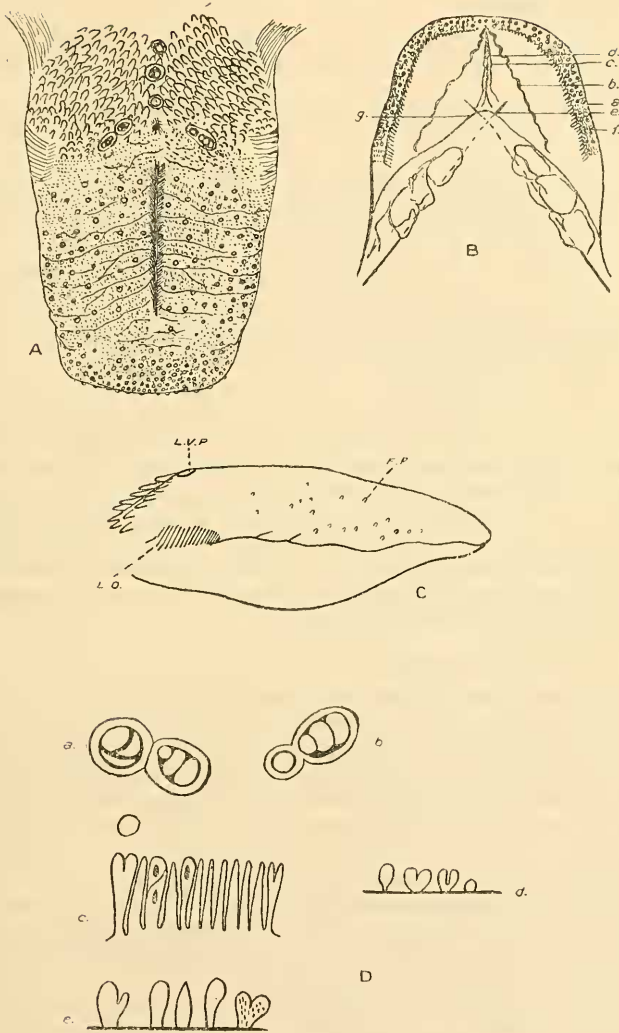
In my specimen there are seven vallate papillæ arranged in the form of a Y, and the notable feature is that most of them are compound. Each lateral limb has two papillæ and the median one has three.

The two papillæ of the right limb are compound (text-fig. 3 D, a) and lie very close together, for their vallums are only separated from one another by a narrow fissure. Both fossæ and vallums are prominent and the papillary elements are recessed below the vallums. The papillary bodies are granulated, possibly as the result of secondary processes.

The outer papilla of the left lateral limb (text-fig. 3 D, b) is compound and the inner one is simple. The fossæ are patulous and the two vallums are in continuity. It seems as if the inner papilla is an element which has been separated off from the outer compound papilla. In the case of the compound papilla the elements are recessed below the vallum, but the simple papilla is more prominent. The surfaces of the elements are granular.

The outer papillæ of the lateral limbs are level with the

Text-figure 3.



The tongue of *Gorilla gorilla*.

A. dorsum ; B. inferior surface ; C. lateral view ; D. *a, b, d, e*, papillæ ; D. *c*, lateral organ showing the lateral vallate papilla above its posterior laminae.

posterior extremities of the lateral organs as in the Orang-Outan (text-figs. 3 A & 3 D, *e*). In the Chimpanzee and Gibbons, on the other hand, they are level with the central rows and sulci of the lateral organs.

The median row of vallate papillæ has three elements. The anterior and posterior ones are simple, but the middle one is compound.

The following numbers and arrangements have been recorded:—

1. Five papillæ in V-formation—Ehlers (23).
2. Five papillæ in V-formation in the fœtus—Deniker (17).
3. Six papillæ in V-formation—Duvernoy (22).
4. Seven papillæ in V-formation—Bischoff (7).
5. Eight papillæ in V-formation—Duvernoy (22).

My specimen, therefore, differs in the type of arrangement of its vallate papillæ from that described by other authors.

The Conical Papille.

The conical papillæ have the same forms and arrangements as in the Chimpanzee, but they are not so large in the anterior two-thirds of the dorsum. Behind the vallate region, however, the large pedunculated papillæ are larger and much more numerous than in the Chimpanzee. These latter papillæ are tapering or club-shaped, and many of them have small secondary processes as described and figured by Bischoff (7). Their points are directed backwards, and some of them overlap the most posterior vallate papilla (text-fig. 3 D, *e*).

The Fungiform Papille.

The fungiform papillæ are not so large or so numerous as in the Chimpanzee, but they exceed those of the Orang-Outan both in size and numbers. They are in clusters behind the apex, in transverse rows farther back, and in oblique chains in front of the vallate papillæ. They are most numerous behind the apex and close to the lateral borders of the tongue, and diminish in numbers towards the mesial sulcus. There are, however, no fungiform papillæ overhung by filiform types.

When the tongue is viewed laterally (text-fig. 3 C, *FP*) one sees how prominent many of the fungiform papillæ are, and some of them appear almost pedunculated. In this connection the Gorilla differs from all the other Anthropoids.

On the sides of the tongue the fungiform papillæ are in vertical chains, and they are in rows passing from without inwards on the inferior surface (text-fig. 3 C, *FP*).

The Lateral Organs (text-fig. 3 C, *LO*, & 3 D, *e*).

The lateral organs of the Gorilla have been omitted from Boulart and Pilliet's paper. They are situated on the edges of the dorsum of the tongue, beginning posteriorly on a level with

the external vallate papillæ of the lateral rows, and extending forwards to a point level with the posterior extremity of the mesial sulcus. The numbers of ridges and elevations are as follows:—

Right organ :	<i>Length</i> 1·3 cm.	<i>Ridges</i> 11.	<i>Sulci</i> 12.
Left organ :	<i>Length</i> 1·35 cm.	<i>Ridges</i> 12.	<i>Sulci</i> 13.

In his study of the tongue of the fœtal Gorilla, Deniker (17) has shown that the lateral organs are better developed than in the adult.

The ridges and sulci just cut the lateral borders of the tongue. They are long, narrow, and tapering; some are twisted and some have secondary fissures.

The Inferior Surface (text-fig. 3 B).

The inferior surface presents for examination a papillary border, a frenum, a sublingual fold, two plicæ fimbriatæ, a mesial crest, and a mesial sulcus which has already been described. It has, therefore, the same structures as the tongue of the Chimpanzee, with the mesial crest in addition.

The *papillary border* maintains the same width across the under surface of the apex, but it widens out from before backwards along the lateral borders. It bears conical and fungiform papillæ whose method of disposition is of the usual type (text-fig. 3 B, *a*).

The most notable feature is a row of closely-set club-shaped conical papillæ bounding the zone internally (text-fig. 3 B, *f*). They increase in size from before backwards, and they lie flat against the surface of the tongue. Some are entire and others are subdivided into lobules as shown in text-fig. 3 D, *d*. In no other Anthropoid tongue is there a uniform row of these papillæ.

The *mesial crest*, or *plica mediana*, is a fold of mucous membrane occupying the ventral mesial sulcus (text-fig. 3 B, *d*). It runs along the anterior border of the frenum, and thins out and disappears on the dorsal surface of the sublingual fold. Deniker (17) considers that it is a remnant of the sublingua of the Prosimiæ.

The *plicæ fimbriatæ* (text-fig. 3 B, *b*) are united anteriorly at the posterior border of the papillary zone on the inferior surface. When they are traced backwards they diverge and become wider and more prominent. They have undulating free margins, and are pale in colour. The mucosa between them is pale and the remainder is pink in preserved specimens, so the plicæ and intervening part together look like a sublingua. A vertical section of the tongue of the Gorilla resembles that of the Chimpanzee (text-fig. 1 D).

The *frenal lamella*, or sublingual fold, is triangular in shape and has a rounded entire apex (text-fig. 3 B, *g*). Wharton's Duets open on its dorsal surface, and the bristles shown in text-fig. 3 B, *e*, pass into them.

Bischoff (7) denied the existence of a *frenum*, but Ehlers (23) and Deniker (17) saw one. In my specimen it runs from the dorsal surface of the sublingual fold to a triangular depression on the inferior surface of the tongue (text-fig. 3 B).

Genus SIMIA.

THE ORANG-OUTAN (*S. satyrus*).

The tongue of the Orang-Outan resembles that of Man in its relative proportions of length and width and certain of its structural peculiarities. I examined three preserved specimens in the Museum of the Royal College of Surgeons, and the following description refers to No. J.421.3. It is designated as specimen No. 1 here.

The *apex* is rounded, has no mesial notch, and possesses conical and fungiform papillæ, but both forms are small.

The *lateral borders* are massive, and have both conical and fungiform papillæ distributed in the usual manner. Only the outer ends of the laminae and sulci of the lateral organs cut the lateral borders of the tongue.

The dorsum has no median or transverse sulci.

The Papillæ.

Papillæ cover most of the dorsum, apex, lateral borders, and a bounding zone on the inferior surface.

The Circumvallate Papillæ.

The following numbers and arrangements of the vallate papillæ have been recorded:—

1. Ten papillæ in V-formation—Flower (28), Boulart and Pilliet [2].
2. Eight papillæ in V-formation—Müncch [1].
3. Seven papillæ in V-formation—Sandifort (271).
4. Three papillæ on each limb of a V—Fick (235).
5. Eight papillæ in the T-form—Traill (206)*.

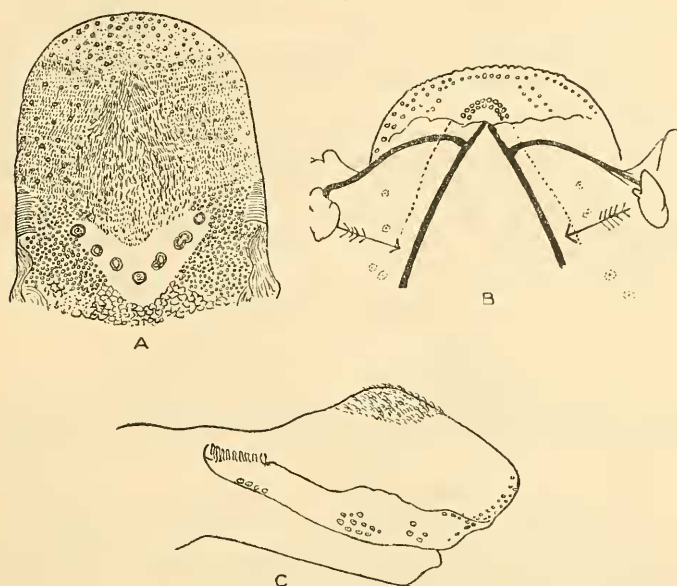
I observed the following numbers and arrangements of the papillæ:—

Specimen No. 1. (text-fig. 4 A).—The papillæ are arranged in the V-form, but the angle embraced by the two limbs is more acute than in Man. There is an apical papilla and three papillæ on each limb, the whole series standing on a raised smooth band of tongue. The papillæ of the left limb are all simple, and the most external one has a small umbilicus (text-fig. 4 A). The most external papilla of the right limb is simple, and the middle and inner papillæ are compound. The apical papilla is compound. All the papillary bodies are round or oval on plan and conical on elevation, with the free broad end of the cone overlapping the vallum. The fossæ are well marked.

* See footnote on page 2.

Specimen No. 2.—The papillæ which are twelve in number, are arranged in the form of a V, but they do not stand on a raised band of tongue as in specimen number one. Several of them are compound.

Text-figure 4.

The tongue of *Simia satyrus*.

A. dorsum; B. ventral surface. The mucosa has been dissected back to show Wharton's Ducts; the arrows point to the actual positions of the sublingual glands, and the dotted lines indicate the positions of the plicæ fimbriatæ.

The Fungiform Papillæ.

The fungiform papillæ are very small. They have the same arrangement in clusters and rows as occurs in the Chimpanzee and Gorilla. In the centre of the dorsum they are concealed by long filiform papillæ. On the inferior surface of the tongue they are larger than on the dorsum, and they are disposed in lines passing from without inwards. A double row forms a prominent arch round the anterior extremity of the frenum (text-fig. 4 B).

The Conical Papillæ.

The conical papillæ are marked features on the anterior two-thirds of the dorsum (text-fig. 4), but they are more pronounced in some individuals than in others. They have the same arrangement in clusters, transverse rows, and oblique chains as in the other Anthropoids, and they increase in size from before backwards and without inwards. They are very long on an area in

the centre of the anterior two-thirds of the dorsum, but, as their points face in all directions, they appear tangled and without any definite method of arrangement. In that central area, again, fungiform papillæ are concealed by the conical forms. There is, therefore, a similarity to the condition already described in the Chimpanzee, and shown in text-fig. 1 A, but the papillæ are more diffused in the latter.

The papillæ belong to the filiform and cylindrical types, but the former predominate, thereby giving the dorsum its shaggy appearance.

The base of the tongue is devoid of the long conical papillæ which are present in the other Anthropoids, and it resembles that of Man in this respect.

On the sides of the tongue they are in vertical chains, and on the inferior surface they are in lines passing from without inwards.

In all situations, except on the central area of the dorsum described above, the points are directed backwards.

The Lateral Organs.

Boulart and Pilliet [2] state that the lateral organs have each twelve laminae, but I found that the numbers of fissures and ridges differ on the two sides as follows:—

Right organ :	Length 1.6 cm.	Ridges 14.	Sulci 15.
Left organ :	Length 1.6 cm.	Ridges 12.	Sulci 13.

The ridges run obliquely from below upwards, and they diminish in size both forwards and backwards, but the organs are continued by simple folds of the mucosa.

The lateral organs end posteriorly on a level with the most external vallate papillæ. The greater part of each lies on the dorsum as in the Gorilla, but some of the anterior laminae and sulci project considerably on to the lateral borders of the tongue.

Lymphoid and Glandular Tissue.

The Orang-Outan agrees with Man and differs from all other Anthropoids in the possession of the *Apical Gland of Nuhn*. Mucous and serous glands occur as usual on the base of the tongue, but there are no large follicles with central pits as in Man and the Chimpanzee.

On the inferior surface there are several small pits surrounded by a raised zone (text-fig. 4 B), but histological examination alone will reveal their true nature. I have been unable to study these as my specimens have been preserved too long in formalin for satisfactory histological work.

The *frenum lingue* is well-marked, as in Man, the *plicæ fimbriatæ* are of no greater development, and the *frenal lamella* is as in the human tongue; it is not a triangular process as

in the other Anthropoids, but simply a fold over Wharton's Ducts.

The tongue of the Orang-Outan, therefore, resembles that of Man in the following particulars:—

1. Its general proportions.
2. Its rounded apex.
3. The V-type of vallate papillæ.
4. The absence of long conical papillæ on the base.
5. The frenum linguæ.
6. The small proportions of the fimbriate plicæ.
7. The nature of the sublingual fold.
8. It has an Apical Gland of Nuhn or Blandin.

In all these particulars it differs from the Chimpanzee and Gorilla, so it must be placed next to that of Man in a classification of tongues.

SYMPHATANGUS.

THE SIAMANG (*S. syndactylus*).

(Specimen No. J. 357.3, Mus. R.C.S.)

The tongue is long and narrow, and the distance between the antero-median vallate papilla and the epiglottis is long (text-fig. 5).

The *apex* is rounded and devoid of a notch. It bears conical and fungiform papillæ which have the usual disposition.

The *lateral borders* are full and rounded. They bear conical papillæ with backwardly-directed points, prominent fungiform papillæ, and the chief parts of the lateral organs. This condition is present in all Gibbons, but the fungiform papillæ vary in size and prominence in different species.

Mesial and transverse sulci are absent on the anterior two-thirds of the dorsum. Both are present on the base of the tongue, but these may have been induced by the preserving fluid.

The mesial ventral sulcus begins at the posterior border of the papillary zone, and runs backwards to open into a triangular depression into which the frenum passes.

The Papillæ.

Papillæ are present on the apex, lateral borders, the entire anterior two-thirds of the dorsum, the sides of the posterior third of the dorsum, and the bounding zone on the inferior surface.

On the posterior third of the dorsum there is a large central area devoid of papillæ (text-fig. 5). It stretches forwards anterior to the median row of vallate papillæ, and sends out limbs on which the lateral papillæ stand. It extends right back to the epiglottis, and is ridged and furrowed at its posterior part. Anteriorly it is bounded by small conical papillæ, and large

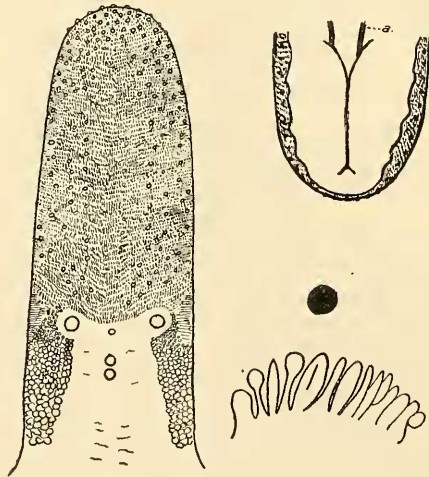
conical papillæ occupy the spaces between its lateral borders and the edges of the tongue.

The Orang-Outan is the only other Anthropoid which has a bare area (text fig. 4 A), but it is V-shaped and smaller in size.

The Circumvallate Papillæ.

Five vallate papillæ are arranged in the form of a Y; of these, three form a mesial row, and there is a right lateral and a left lateral papilla. All the papillæ are circular on plan and conical on elevation, and the fossæ are well-marked. But the vallums are not demarcated off from the smooth area on which the papillæ stand. All have smooth bodies, and the right and left lateral ones are umbilicated.

Text-figure 5.



The tongue of *Symphatagus syndactylus*, showing the dorsum, inferior surface, and right lateral organ with lateral vallate papilla.

The Fungiform Papilla.

The fungiform papillæ are present over the anterior two-thirds of the dorsum except for a zone along the mid-line. They have the usual distribution in clusters and rows, and are never very large nor concealed by conical papillæ. On the lateral borders and inferior surface they are arranged in lines running vertically or from without inwards.

The Conical Papillæ.

They have the usual form of distribution in clusters and ridges, and their characters are visible to the naked eye right forward to the apex. Most of them are filiform with the points directed backwards, or backwards and inwards.

The conical papillæ on the base increase in size from before backwards, but they never attain the degree of development which is exhibited on the tongues of the Chimpanzee or Gorilla. They belong to the cylindrical type, and many of the large ones at the base have long hair-like processes. These basal papillæ are arranged in two groups—one on each side of the non-papillary area.

No *foramen cæcum*, *lytta*, or *plicæ fimbriatæ* are present.

The Lateral Organs (text-fig. 5).

The two lateral organs, which are convex inwardly, have the following measurements, etc. :—

Right organ :	<i>Length</i> 1·3 cm.	<i>Ridges</i> 11.	<i>Sulci</i> 12.
Left organ :	<i>Length</i> 1·3 cm.	<i>Ridges</i> 12.	<i>Sulci</i> 13.

The organs are situated chiefly on the sides of the tongue, but the inner extremities of their laminae and sulci extend on to the dorsum. Anteriorly and posteriorly they are continued by simple folds of mucous membrane. These characters are common to all the Gibbons and the Chimpanzee.

The lateral vallate papillæ are level with the laminae and ridges of the posterior halves of the organs, but they are not so far back as in the Gorilla or Orang-Outan, and not so far forwards as in the Chimpanzee and many other Gibbons.

There are no *lymphoid nodules* with central pits on the base of the tongue.

The *frenum* is short, and runs from the floor of the mouth to a triangular depression on the inferior surface of the tongue.

The Siamang is the only Gibbon which has no bifid triangular *sublingual fold* through which Wharton's Ducts pass. The latter open on *caruncle sublinguales*, as in the Orang-Outan, but it was not at all clear if these were overlapped by *plicæ* in the specimen which I examined.

In the presence of the bare area on the base of the dorsal surface and in the characters of the openings of Wharton's Ducts, the tongue of the Siamang agrees with that of the Orang-Outan, and differs from the tongues of all the other Simiidae.

Genus HYLOBATES.

THE SLENDER GIBBON (*H. agilis*).

I have not had the opportunity of examining the tongue of *H. agilis*, but Flower (28) points out that it has the following characters :—

1. The tongue narrows slightly from base to apex.
2. The apex is obtusely rounded.
3. The vallate papillæ are small, irregularly placed, and adopt the V-formation.
4. Fungiform papillæ are large and evenly distributed

5. Conical papillæ short and thick on the anterior part of the dorsum.
6. Conical papillæ at the base of the tongue large, soft, and pointed.
7. Lateral organs distinct.
8. Sublingual fold bifid.

THE HOOLOCK GIBBON (*H. hoolock*).

(Specimen No. J. 357.2, Mus. R.C.S.)

The tongue is short, compact, and rough, and tapers from base to apex (text-fig. 6).

The *apex* is rounded and has no mesial notch. It bears conical and fungiform papillæ, but the latter are small and inconspicuous. The *lateral borders* are the same as in *S. syndactylus*, but are shorter.

The Papillæ.

The papillæ have the usual general distribution, but there is no smooth non-papillary area at the base as in *S. syndactylus*.

The Circumvallate Papillæ.

There are four vallate papillæ arranged in the Y-form. Two are mesial, and there is a right and a left lateral papilla (text-fig. 6).

The right and left lateral papillæ are level with the central laminae and sulci of the lateral organs. They are circular on plan and conical on elevation, the narrow ends being attached to the bottoms of the fossæ. The fossæ are plain, and the vallums are lobulated and surrounded by conical papillæ.

The two mesial papillæ (text-figs. 6 & 9, 19) are close together. The anterior one is circular and the posterior one is oval on plan, and both are conical on elevation with the broad ends free. Both lie within a depression surrounded by a prominent lobulated ridge of mucosa, and the space between them and the latter is crowded with small cylindrical conical papillæ. The fossæ are not very prominent. All around the common rampart there are conical papillæ.

The Fungiform Papillæ.

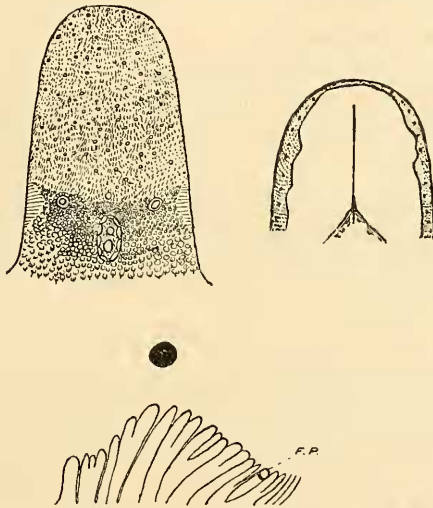
The fungiform papillæ are *disposed* over the whole of the anterior two-thirds of the dorsum. As many of them are concealed by the conical papillæ, it is necessary to employ a lens to detect them all. The largest ones on the *dorsum* are immediately in front of the vallate papillæ, but all the others are small. There are few on the *lateral borders* of the tongue. On the papillary zone of the *inferior surface* they are larger than anywhere else. They occupy most of the zone beneath the apex, but farther back they are arranged in an irregular double row, on which some of the papillæ are hemispherical and others are

pedunculated. Some run into the lateral organs (text-fig. 6, *FP*).

The Conical Papillæ.

On the anterior two-thirds of the *dorsum* the conical papillæ are strong and coarse, and give the tongue a rough appearance. Their disposition in clusters and rows is not very clearly marked, but is maintained. Several groups are arranged in an undulating manner, and the points of the papillæ point backwards, backwards and outwards, or backwards and inwards (text-fig. 6). They conceal several of the fungiform papillæ.

Text-figure 6.



The tongue of *Hylobates hoolock*, showing the dorsum, inferior surface, and right lateral organ.

Behind the *vallate papillæ* the tongue is covered with cylindrical conical forms. On the area lying between the lateral vallate papillæ and the level of the posterior pole of the rampart common to the two mesial vallate papillæ they are small, but behind that level they are large, and many have strong single processes (text-fig. 9, 5). There are some small cylindrical forms anterior to the vallate papillæ.

The characters and disposition of the conical papillæ on the sides and inferior surface are the same as in all other Anthropoids.

The Lateral Organs (text-fig. 6).

Right organ: Length 1.2 cm.	Ridges 12.	Sulci 13.
Left organ: Length 1.25 cm.	Ridges 10.	Sulci 11.

Both organs are convex inwardly and lie on the lateral borders, with the inner extremities of their ridges and sulci on the dorsum. In the specimen (No. J. 357.2, Mus. R.C.S.) which I examined more of the left organ is on the dorsum, but that may be produced by mechanical distortion. Most of the ridges are subdivided, and fungiform papillæ invade the anterior ones on both organs. Simple folds of the mucosa lie anterior to each organ, and the lateral vallate papillæ are level with the central laminae and sulci.

The following structures are absent :—

1. Large lymphoid nodules with central pits.
2. Lytta.
3. Plicæ fimbriatæ.
4. Apical gland of Nuhn.
5. Foramen cæcum.

The *frenum* is of moderate length.

The *ventral mesial sulcus* is narrow, deep, and lodges an antero-posterior crest. It runs back from the posterior border of the papillary zone to the triangular depression into which the frenum passes.

The *bifid sublingual fold* is not present in the specimen in the Museum of the Royal College of Surgeons, and the frenum passes straight from the triangular pit on the inferior surface of the tongue to the mucous membrane of the floor of the mouth.

THE BORNEAN GIBBON (*H. muelleri*).

The specimen described below was obtained from a female Gibbon from Borneo which died in the Society's Menagerie.

Measurements.—Total length 6.5 cm.; length from the apex to the central vallate papilla 5.25 cm.; length from the central vallate papilla to the epiglottis 1.25 cm.; width between the attachments of the anterior faucial pillars to the edges of the tongue 2.8 cm.; width of the apex 1.4 cm.; thickness at the central vallate papilla 1.2 cm.; thickness of the apex .6 cm.

The tongue is, therefore, long and narrow, and it is pigmented.

Pigmentation.—The dorsum in front of the vallate papillæ is bluish black in colour, and the glistening bluish-black fungiform papillæ appear prominently on it, as their colour is darker than the rest of the dorsum. The dorsum behind the vallate papillæ is not pigmented, is white, and the lateral organs lie at its antero-lateral aspects.

The inferior surface has a central unpigmented area shaped like the head of a spear, whose apex reaches the posterior border of the papillary bounding zone. From the posterior extremity of the hastate central area a narrow clear band runs on each side to the lateral organ, and thus brings the clear areas of dorsum

and inferior surfaces into continuity. The rest of the inferior surface is bluish black in colour.

Apex.—The obtuse apex has a fine central notch. It bears fine conical papillæ on the dorsum and lateral borders, and both conical and fungiform papillæ on the inferior surface. The conical papillæ are of the cylindrical and filiform types, and the latter have their points directed backwards. The numbers of points differ greatly.

Median sulci.—Median longitudinal sulci are present on both dorsum and inferior surfaces. The median dorsal sulcus runs back from the apex for a distance of 1·4 cm. The median inferior sulcus begins at a point ·5 cm. posterior to the apex for 1·5 cm., becoming wider as it goes, till it opens into a triangular area to which the frenum is attached. It is shut off from the apex by the papillary border.

Lateral borders.—The lateral borders have fungiform and conical papillæ. The latter are both cylindrical and filiform with their points directed backwards.

The inferior surface.—The inferior surface is surrounded by a papillary border which is rough to the touch; it varies in width from ·2 cm. at the apex to ·5 cm. at the lateral organs, so it becomes wider when it is traced backwards. It bears both fungiform and conical papillæ. The former are arranged in two rows, of which the inner one consists of closely-set elements, but the outer papillæ are more discrete. There is, however, no disposition according to size, for both rows have different sizes of members. The conical papillæ are cylindrical and filiform with their points directed backwards.

Internal to the papillary border the mucous membrane is smooth and, with the exception of the mesial sulcus, furrowless.

Plicæ fimbriatæ, lytta, foramen cæcum, and the *Apical gland of Nuhn* are absent.

The Papillæ.

Papillæ cover the entire dorsum, the apex, lateral borders, and a bounding zone of the inferior surface.

The Circumvallate Papillæ.

There are three vallate papillæ arranged in the form of a triangle whose apex is in the mid-line posteriorly, and the vertical angle included is obtuse. The lateral papillæ, which are simple, are ·7 cm. distant from the compound apical papilla and 1·3 cm. from one another.

The apical papilla is very prominent, is oval in shape with the long axis antero-posterior, and measures ·6 cm. by ·3 cm. Its fossa is narrow and irregular, and lodges two elements (text-figs. 7 & 9, 17). These have smooth glistening bodies, and the anterior one has a small central depression. The entire series of elements is dumb-bell-shaped and the vallum sends small lobules

into its hollows. The vallum is finely lobulated. Perhaps this papilla has been formed by fusion of elements similar to those in the mesial limb of *H. hooleck* (text-fig. 9, 19).

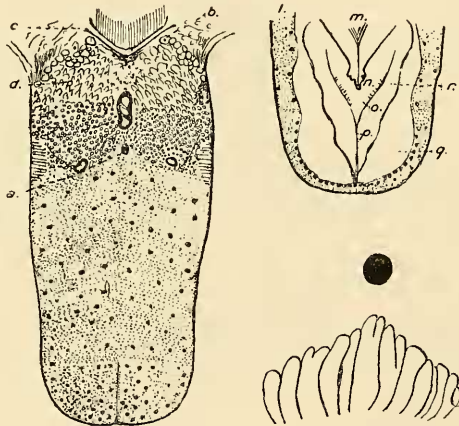
The two simple lateral papillæ are ovoid, and the papillary bodies and vallums are granular (text-fig. 7).

All the papillæ are conical on elevation, the broad ends of the cones projecting beyond the vallums (text-fig. 9, 17).

The Conical Papillæ (text-fig. 9, 1-13).

The conical papillæ have the usual arrangement in clusters and rows of varying degrees of obliquity, and belong to the cylindrical and filiform series. The latter have one or more points, all of which are directed backwards. Those shown in text-fig. 9, nos. 1-5, have shafts circular on section, but the papillæ (text-fig. 9, 6-8) are flat.

Text-figure 7.



The tongue of *Hylobates muelleri*.

a, central fungiform papilla; *b*, *d*, conical papillæ; *c*, epiglottis; *l*, papillary bounding zone of inferior surface; *m*, part of frenum; *n*, frenal lamella; *o*, *p*, mesial ventral sulcus; *q*, pigmented area; *r*, unpigmented area.

At the base of the tongue there are large conical papillæ whose points are directed backwards and inwards. Their surfaces are granular, and they may have prominent secondary papillæ. They are not so well developed as in the Gorilla and Chimpanzee, but their secondary processes are larger than in either of these animals. They are shown in text-fig. 9, 9-13.

The Fungiform Papillæ (text-fig. 9, 14-16).

There is little to note about the fungiform papillæ. They have the same type of arrangement as in the other Anthropoids, and

they are evenly distributed. They are most numerous behind the apex on the dorsum and inferior surface.

The Lateral Organs.

The lateral organs, as in the Chimpanzee, lie on the sides of the tongue, with the upper ends of their fissures and ridges projecting on to the dorsum (text-fig. 7). Each organ is convex inwards, and has both plain and subdivided ridges. The two organs are compared as follows:—

Right organ :	<i>Length</i> .9 cm.	<i>Ridges</i> 12.	<i>Sulci</i> 13.
Left organ :	<i>Length</i> .9 cm.	<i>Ridges</i> 11.	<i>Sulci</i> 12.

The middle ridges and sulci of the lateral organs are level with the lateral vallate papillæ.

Lymphoid Tissue.

Small and large lymphoid nodules are present on the base of the tongue, and some of the large ones have central pits which are, however, larger than in the Chimpanzee.

The Frenum.

The frenum is short and thick. It runs from the upper surface of the sublingual fold to be inserted into a triangular depression on the under surface of the tongue and from its under surface to the floor of the mouth.

The Sublingual Fold.

The sublingual fold is triangular, and has a bifid apex and crenated edges.

THE WHITE-HANDED GIBBON (*H. lar*).

I examined two preserved specimens (Nos. J. 357.1 & J. 357.2) in the Museum of the Royal College of Surgeons. The former is oval in shape and the latter is conical, but the differences in form are possibly due to varying degrees of muscular contracture. They both differ also in the character of their papillæ and lateral organs. Unless differences are specifically stated here, the characters described are common to both.

The *apex* is similar to that of *S. syndactylus*.

The *lateral borders* are full and rounded. They possess both conical and fungiform papillæ, and the latter are very prominent; some are hemispherical and others are pedunculated. At their posterior extremities the lateral organs are situated.

No *mesial sulci* are present on any part of the dorsum.

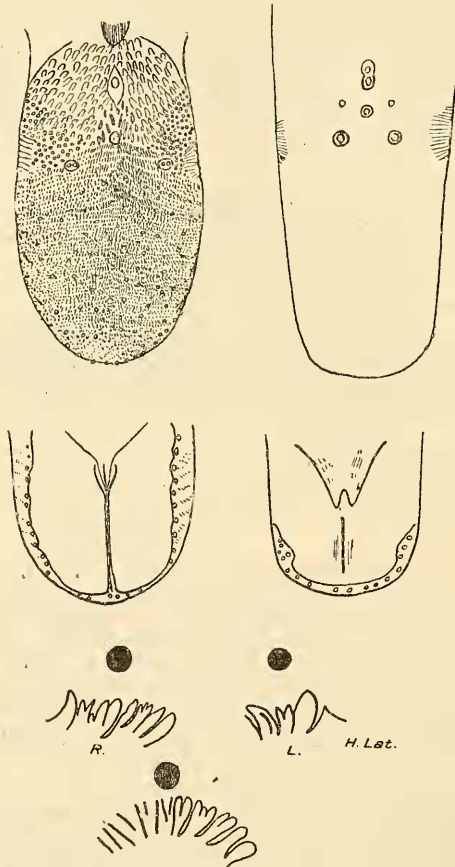
The Papillæ.

The papillæ have the same distribution as in *H. muelleri* and *H. hoolock*, and there is no smooth area on the base of the tongue as in *S. syndactylus*.

The Circumvallate Papillæ.

In specimen No. J. 357.1 there are four papillæ arranged in the Y-formation. These are so disposed that there is a right lateral papilla, a left lateral papilla, and two mesial papillæ—anterior and posterior. All are small in size.

Text-figure 8.

The tongue of *Hylobates lar*.

Two forms are shown, with dorsum (upper row) and inferior surface (middle row).

The figures R and L are lateral organs of the figure on the right hand, and the unmarked lateral organ belongs to the left one.

The lateral papillæ are oval and subdivided into two by fissures, and the vallums and fossæ are not very obvious.

The mesial papillæ are small, the vallum of the anterior papilla consists of two crescentic ridges, and the vallum of the posterior papilla is large and fusiform.

The Fungiform Papillæ.

The fungiform papillæ have the usual disposition in rows and clusters. They tuberculate the apex. There are few on the lateral borders, but they are numerous and prominent on the anterior part of the papillary zone of the inferior surface. They vary in prominence in different tongues, and the degree in which they are concealed by conical papillæ also varies. There is a prominent cluster immediately in front of the vallate papillæ, and some invade the vallate Y and are hard to distinguish from them.

The Conical Papillæ.

Most of the conical papillæ are of the filiform type, and have the usual type of arrangement on the dorsum, lateral borders, and inferior surface. Their points are directed backwards, or backwards and inwards, and they increase in size from before backwards and without inwards. They conceal the anterior fissures and ridges of the lateral organs.

At the sides of, and posterior to, the vallate papillary Y they become large and oval or round, with the apices directed backwards and inwards, and the round ones have each a long central spine.

The Lateral Organs.

Specimen 1 (text-fig. 8, R. & L.).

Right organ: Length .8 cm. Ridges 5. Sulci 6.

Left organ: Length .8 cm. Ridges 4. Sulci 5.

Specimen 2 (text-fig. 8).

Right organ: Length 1.2 cm. Ridges 10. Sulci 11.

Left organ: Length 1.25 cm. Ridges 10. Sulci 11.

The lateral organs differ in character in the two specimens. In specimen 1 there are six or five sulci appearing as slits running obliquely forwards and upwards, and the intervening laminae are coarse, short, and not greatly raised above the level of the surface of the tongue. In the second specimen the organs have the appearance usual in all the other Gibbons.

The following structures are absent:—

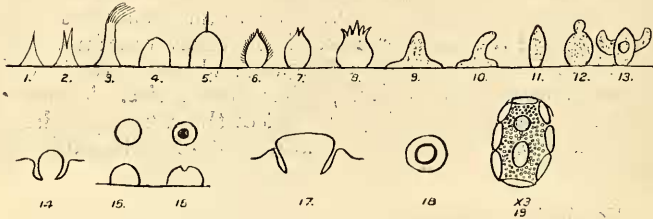
1. Lymphoid nodules with central pits.
2. Lytta.
3. Foramen cæcum.
4. Plicæ fimbriatæ.

The *sublingual fold* is triangular in shape with a bifid apex. From its upper surface the short *frenum* passes to the inferior

surface of the tongue and from its under surface to the floor of the mouth.

The *ventral mesial sulcus* begins anteriorly at the posterior border of the papillary zone. It is narrow and deep, and lodges a small median crest.

Text-figure 9.



Papillæ of the Gibbons.

1-13, conical papillæ; 14-16, fungiform papillæ; 19, vallate papillæ of *H. hoolock*.

SUMMARY AND CONCLUSIONS.

1. Apical notches and mesial dorsal sulci are more frequently absent than present, and are of no particular value for comparative purposes.

2. The lateral borders have the same characters as regards papillæ in all forms. In the Chimpanzee and Gibbons they lodge the greater part of the lateral organs, but in the Gorilla and Orang they only lodge a small part.

3. The vallate papillæ are usually fewer than in Man (7-12). In the Orang they are in V-formation, but they usually assume the Y-type in others. Compound papillæ are common.

4. Filiform papillæ are the predominating type of the conical group on the anterior two-thirds of the dorsum.

5. The long conical papillæ on the base are largest in the Gorilla, smaller in the Chimpanzee, smallest in the Gibbons, and absent in the Orang.

6. Only the Orang and Siamang have smooth non-papillary areas on the base.

7. Plicæ fimbriatæ are absent in the Gibbons.

8. Median ventral crests occur in the Gorilla and some Gibbons.

9. The Orang and Siamang have no triangular sublingual fold, but all the other Simiæ possess one. In the Gorilla the apex is entire, but in all the rest it is bifid.

10. Only Man and the Orang have the Apical Gland of Nuhn.

11. The tongue of the Orang resembles that of Man more closely than any other one does, and the tongue of the Bornean Gibbon resembles, in many ways, those of the Cercopithecues, which will be described in my next paper.

BIBLIOGRAPHY.

The numbers included in round brackets correspond with those in Professor Arthur Keith's "Introduction to the Study of the Anthropoid Apes" (Natural Science, vol. ix. 1896, Rep. 1897). Those included in square brackets refer to the following papers not mentioned by Professor Keith:—

1. MÜNCH.—Morphol. Arbeiten, Bd. 6, pp. 605-690. 1896.
2. BOULART & PILLET.—Journ. de l'Anat. et de la Physiologie, Paris, 1885, p. 337.

[I was unable to see the characters of the part of the frenum running between the inferior surface of the frenal lamella and the floor of the mouth in the specimens in which I have not specifically described this part.]